DOE/RL-2002-59

Hanford Site Groundwater Strategy

Protection, Monitoring, and Remediation

July 2003

United States
Department of Energy

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United States
Department of Energy
P.O. Box 550
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Preface

This document was prepared as a collaborative effort by the Washington State Department of Ecology, the U.S. Environmental Protection Agency, and the U.S. Department of Energy (Tri-Parties) as part of the 2002 Cleanup Constraints and Challenges Initiative by the Tri-Parties. This document presents a strategy for multiple regulatory authorities and government agencies to effectively protect and restore groundwater at the Hanford Site. This is not a decision document and it does not add to or change existing agreements, milestones and commitments between the Tri-Parties nor does it change regulatory requirements and procedures of the Tri-Parties.

1.0 Mission

The mission of the Hanford Groundwater Protection Program is to protect the Columbia River from contaminated groundwater resulting from past, present, and future operations at the Hanford Site and to protect and remediate groundwater.[1] This mission is a key element of the overall Hanford cleanup effort.

This document provides a strategy to accomplish the mission through groundwater protection, monitoring, and remediation. Additionally, the document identifies how the information related to this strategy and its implementation will be made available to interested parties. This is a strategy document only – specific groundwater decisions will be made through the appropriate regulatory process. For a list of documents defining details of the process, see Section 6.1 of this document. Also not addressed are long-term stewardship and vadose zone monitoring. The U.S. Department of Energy (DOE) is developing a long-term stewardship plan and studying the applicability of vadose zone monitoring.

2.0 Objective

A key objective of the U.S. Department of Energy is to clean up Hanford so that human health and the environment is protected. The Groundwater Protection Program is an important piece of DOE's overall Hanford cleanup strategy. To achieve the objective, the Tri-Parties' strategy minimizes adverse effects to groundwater during site operations, cleanup and long term stewardship with groundwater protection, monitoring, and remediation activities that:

- Satisfy regulatory requirements
- Integrate Resource Conservation and Recovery Act (RCRA), Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) and Atomic Energy Act of 1954 (AEA) requirements
- Minimize duplication and reduce inconsistencies for monitoring and well drilling that arise from the multiple regulations
- Support vadose and groundwater cleanup decisions in a timely, effective, and efficient manner

The groundwater strategy provides a consistent rationale to evaluate protection, monitoring, and remediation activities and identify gaps in groundwater and vadose remedial actions. The strategy guides

[1] As a regulatory requirement and policy objective in both the RCRA and CERCLA programs "EPA expects to return usable ground waters to their beneficial uses wherever practicable, within a time frame that is reasonable given the particular circumstances of the site. When restoration of groundwater to beneficial uses is not practicable, EPA expects to prevent further migration of the plume, prevent exposure to the contaminated ground water and evaluate further risk reduction." – 40 CFR 300.430(a)(1)(iii)(F)

field activities conducted at the Hanford Site and facilitates annual negotiations between the Tri-Parties: U.S. Environmental Protection Agency (EPA), Washington State Department of Ecology (Ecology) and DOE and the related work planning. For the areas of agreement between the Tri-Parties that provide a basis for this groundwater strategy, see Appendix B.

3.0 Goals

The goals of the groundwater strategy to achieve this objective are to:

- Identify regulatory requirements and environmental objectives to protect, monitor, and remediate groundwater
- Provide a clear mechanism to achieve the mission of the Hanford Groundwater Program by integrating RCRA, CERCLA, and AEA requirements and minimizing overlap, duplication, and inconsistencies
- Provide a framework that relates data needs to the decisions needed for remedial activities and monitoring
- Expand the scientific understanding and engineering knowledge necessary to support the decision making process
- Develop a strategy that can be adapted as new information emerges
- Identify and integrate policy issues that affect the Tri-Parties
- Focus action on the reduction of risk; characterization, monitoring, and other activities support that end
- Protect and remediate groundwater considering the cumulative impact of waste remaining at the Hanford Site, regulatory requirements, and stakeholder values
- Meet risk-based cleanup objectives through an appropriate combination of reduction of contaminant mass and containment of plumes to minimize the spread of contamination
- Minimize further degradation of groundwater consistent with state and federal anti-degradation policies, during remedial and closure activities (for example, tank waste retrieval), including the reduction of preferential pathways such as abandoned wells

4.0 Regulatory Integration

Hanford groundwater protection, monitoring, and remediation actions are guided by both federal and Washington State regulations. The primary relevant acts are RCRA, CERCLA, and AEA.

4.1 RCRA Groundwater Activities

Groundwater monitoring at the Hanford Site under RCRA requirements and the implementing regulations of the Washington Administrative Code (WAC) 173-303 focuses on several key areas:

- Verification that operation and management of currently active RCRA land-based waste management units "regulated units" (as defined in WAC 173-303-040), that are currently receiving dangerous waste, will protect groundwater

- Verification of closure performance standards for cleanup of groundwater and monitoring of groundwater for closed/closing land-based regulated units

- Corrective action for solid waste management units--RCRA past-practice units identified in the *Hanford Federal Facility Agreement and Consent Order*, Tri-Party Agreement (Ecology et al. 1998) Appendix C nomenclature

All groundwater monitoring requirements for units subject to RCRA operating, closure/post-closure or corrective action requirements will be included in the Hanford site-wide permit pursuant to WAC 173-303-645 (for land-based regulated units) and WAC 173-303-646 (for RCRA past practice units). To date, permit conditions have not yet been developed for all RCRA land-based regulated units in Appendix B or RCRA past-practice units in Appendix C of the Tri-Party Agreement. As operating, closure/post-closure and corrective action conditions are developed pursuant to the M-20 schedule, however, associated groundwater monitoring requirements will be based on satisfaction of the cited regulatory requirements.

Groundwater monitoring for active RCRA land-based units "regulated units" (such as landfills and surface impoundments) is conducted on a unit-specific basis to document that current waste management activities do not adversely affect groundwater. Groundwater monitoring for closed/closing RCRA land-based units (regulated as defined by WAC 173-303-040) may either be on a unit-specific basis according to WAC 173-303-645(2) or as part of a broader groundwater operable unit monitoring program according to WAC 173-303-645(1) E. The monitoring approach selected for a particular waste management unit depends on a number of factors that include the source inventory of the waste management unit, the mobility and toxicity of waste or constituents in the waste management unit, similarity of contamination in the waste management unit and the associated groundwater operable unit, and the relative contribution of contamination from the waste management unit compared to the associated groundwater operable unit.

Groundwater monitoring for single-shell tanks is a complex, special case that is dealt with separately under Tri-Party Agreement milestones M-24 and M-45. Single-shell tanks are considered non-compliant tank systems with documented releases to the environment but which must continue to be used to manage waste for an extended period of time pending retrieval and closure. Groundwater monitoring at the single-shell tanks supports numerous environmental and regulatory data needs, including evaluating the sources of groundwater and vadose contamination, the fate and transport of existing and potential future releases, the aquifer characteristics for purposes of evaluating retrieval technologies, and the long-term risk for purposes of developing closure performance standards and post-closure care requirements.

Site-specific characteristics shall determine monitoring needs. Where appropriate, groundwater monitoring programs shall be designed and implemented in accordance with 40 CFR 264, Subpart F, or 40 CFR 265, Subpart F. For sites with multiple sources of groundwater pollutants, extensive groundwater pollution, or other unique site problems, groundwater monitoring programs could require more extensive information than those specified in 40 CFR 264 and 265. Monitoring for radionuclides shall be in accordance with DOE Orders dealing with radiation protection of the public and the environment and radioactive waste management.

Additional regulatory analysis is provided in Appendix A of this document.

4.2 CERCLA Groundwater Activities

The Hanford Site has been divided into 56 operable units, or groupings of similar waste units within a geographic area, so that the CERCLA process established in the National Oil and Hazardous Substances Contingency Plan (40 CFR 300) can be efficiently implemented. Forty-six are source operable units and eleven are ground water operable units. The concept of the groundwater operable unit was adopted to allow separate characterization of the source operable units and the groundwater. Separate characterize-tion recognizes differences between the more localized contaminants in the soil column at the sources and the more widespread distribution of groundwater contaminant plumes that have resulted from one or more individual sources. Monitoring wells are located and sampled in accordance with Remedial Investigation/ Feasibility Study (RI/FS) work plans to define the nature and extent of the contaminant plume(s).

In developing a site-wide groundwater monitoring strategy, the Tri-Parties also recognize the distinction between groundwater remediation and source remediation. Characterization and monitoring are essential elements of both. In addition, the Tri-Parties recognize the distinction between active waste management units and waste sites undergoing cleanup.

EPA, DOE, and Ecology affirm Section 5.5 of the Tri-Party Agreement (Ecology et al. 1998), which recognizes the need to coordinate the application of regulatory requirements, and recognize that past-practice authority may provide the most efficient means to address groundwater plumes of mixed waste originating from a combination of past-practice treatment, storage, and disposal units. Groundwater response actions for which EPA is the lead regulatory agency shall ensure compliance with the technical requirements of RCW 70.105 and implementing regulations. Notwithstanding this operating assumption, Ecology reserves the right to exercise its authority under RCW 70.105 to require response actions specific to the treatment, storage, and disposal facilities.

4.3 Atomic Energy Act Groundwater Activities

Under the authority of AEA, DOE is required to implement a groundwater program at the Hanford Site. Groundwater that is or could be affected by DOE activities shall be monitored to determine and document the effect of operations on groundwater quality and quantity and to demonstrate compliance with DOE requirements and applicable federal, state, and local laws and regulations. The elements of the groundwater monitoring program shall be specified (sampling plan, sampling, analysis, and data management) as shall the rationale or purpose for selecting these elements. Groundwater monitoring programs shall be conducted on-site and in the vicinity of DOE facilities to:

1. Obtain data for the purpose of determining baseline conditions of groundwater quality and quantity

2. Demonstrate compliance with and implementation of all applicable regulations and DOE Orders

3. Provide data to permit the early detection of groundwater pollution or contamination

4. Provide a reporting mechanism for detected groundwater pollution or contamination

5. Identify existing and potential groundwater contamination sources and maintain surveillance of these sources

6. Provide data upon which decisions can be made concerning land disposal practices and the management and protection of groundwater resources

5.0 Strategies

This groundwater strategy focuses on three key areas:

- Groundwater protection

- Groundwater monitoring

- Remediation of contaminated groundwater

Strategy elements for each of these areas are presented in the following sections. Each section also identifies areas for technology improvements and the role of groundwater modeling. Actions to be taken to communicate groundwater plans and the results of actions taken are discussed in Section 6.

5.1 Groundwater Protection

Once deep vadose zone and/or groundwater become contaminated it is difficult and costly to remediate. Therefore, prevention of future groundwater contamination and containment of existing near-surface contamination are the primary ways to protect groundwater. Key activities in preventing future groundwater contamination include operating and managing properly the existing and new land-based waste storage and disposal facilities, removing or immobilizing contaminant sources before contamination can reach groundwater, reducing natural and artificial recharge in contaminated areas, and eliminating the opportunity for contaminants to move rapidly to groundwater along unsealed well casings and through deteriorating wells that are no longer needed or used.

5.1.1 Groundwater Protection Framework

Operation of Waste Storage and Disposal Facilities. Permanent onsite disposal of waste is an integral component of the overall Hanford cleanup mission, including clean up and protection of groundwater. Managing this waste must be based on the principle of preventing human health or environmental harm through proper waste management practices. Proper operation of active waste storage and disposal facilities is a key element to ensure continued protection of groundwater. Avoiding new and/or preventing additional contamination from entering the groundwater from both new and existing operations are a primary objective in facility management. Design and operation of waste management units currently accepting RCRA regulated waste (including new or expanded units) must reflect the minimum technology and groundwater monitoring requirements of RCRA. More specifically, hazardous/dangerous waste disposal units are fully subject to groundwater detection monitoring, compliance monitoring, and corrective action requirements of WAC 173-303-645.

Removal or Immobilization of Contaminant Sources. Removal of contaminant sources, immobilization of the waste, remediation of waste releases at the sources, and/or minimization of contaminant transport at the sources helps protect groundwater by controlling the source of the contaminants. Considerable progress has been made in the Columbia River corridor in this respect. Plans are being developed to accelerate the cleanup of the remaining sites in the river corridor and accelerate cleanup of the core zone (Figure 1) including treating tank waste, remediating waste sites, and decommissioning excess facilities (DOE/RL 2002). Each of the actions taken in these areas will reduce the potential for degradation of groundwater quality.

Reducing Natural and Artificial Recharge in Contaminated Areas. Reducing natural and artificial recharge in contaminated areas protects groundwater by reducing the transport of contaminants through the vadose zone into the unconfined aquifer. Much has been done at the site to eliminate discharge of cooling and process water to the ground. Work has begun to provide run-on/runoff control measures in and around tank farms, remove unnecessary water lines, and test necessary water lines to reduce recharge from precipitation and water line leaks.

Decommissioning Unnecessary Wells. Many wells and borings no longer serve a useful purpose at the Hanford Site. These wells and borings can provide an avenue to speed contamination through the vadose zone to the unconfined aquifer and possibly deeper. These wells and borings fall into three broad categories:

- Wells that have gone dry due to the decline of the top of the unconfined aquifer
- Older wells that are noncompliant
- Wells that no longer serve an exploration, assessment, or regulatory purpose

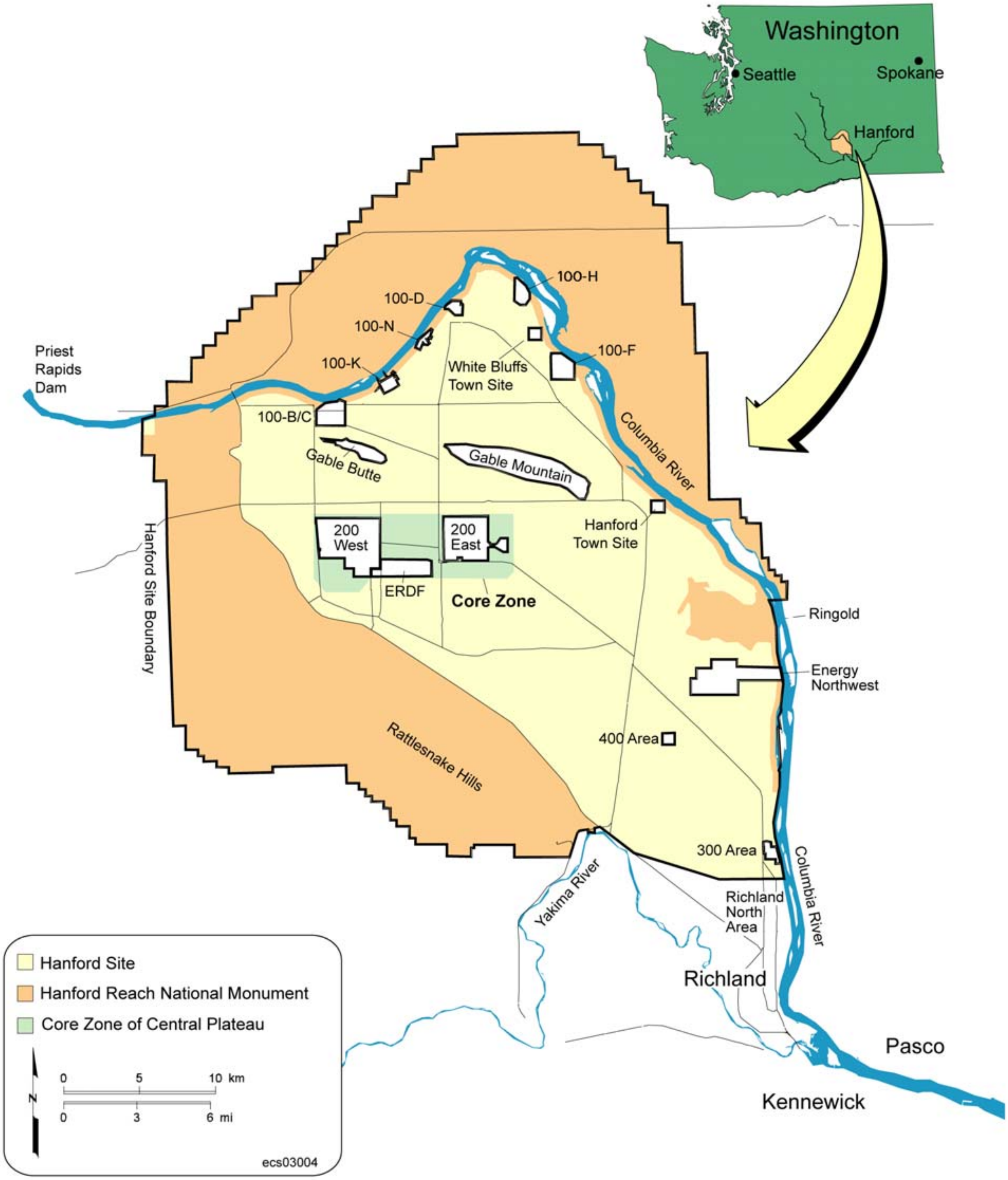

Figure 1. Location of the Core Zone and other key features at the Hanford Site

To aid in protecting the aquifer from mobile contamination, it is important that these wells and borings be removed. When it is determined they are not necessary and/or will not or cannot be used, they should be properly decommissioned. As part of the groundwater protection strategy, a priority ranking system will be developed to determine which wells pose the highest environmental risk and, therefore, should be decommissioned first.

Science and Technology. Science and technology development are needed long term to support groundwater protection at the Hanford Site. Cost reduction and improved effectiveness of protection actions can be realized through continuing investments in these areas.

Modeling and Assessment to Support Groundwater Protection. As alternate disposal and remedial actions are considered, computer models are used to assess the cumulative risk and impact of materials left at the Hanford Site. For groundwater protection, models can be used to:

- Identify and rank sites according to those that pose a future threat to groundwater quality (for example, magnitude of flux of contaminant through the water table)

- Assist in the prioritization of waste sites for accelerated action (for example, the risk to public for alternative actions can be estimated so that it can be considered along with cost, schedule, worker risk in selecting the remedy to apply).

The assessments performed with the help of models will complement the data collected on the performance of implemented disposal and remedial actions (for example, from the 5-year reviews of the records of decision), and provide the final cumulative assessment of long-term risk and impact prior to closure of the Hanford Site.

5.1.2 Considerations for Near-Term Action

DOE will continue to operate Hanford waste treatment, storage and disposal facilities in accordance with applicable permits and regulations. Waste sites will be reviewed to identify sites that warrant accelerated removal of the source. Sites also will be reviewed to identify opportunities to reduce recharge and transport of contaminants into groundwater through placement of interim covers and run-on/runoff control measures. This effort will focus on sites with significant inventory of long-lived, mobile radionuclides and chemicals where an opportunity exists to slow or delay the release of this material to the groundwater.

The water supply and disposal infrastructure in the core zone (see Figure 1) also will be examined to identify actions to reduce influx of water near waste sites. This may include the cutting and capping of water lines and reduction of sanitary sewer disposal in the vicinity of waste sites. In addition, unused wells in areas where they continue to offer a potential pathway for contaminants to reach groundwater will be given a high priority for decommissioning.

Technology development will continue to help characterize where contaminants are and how they are moving as well as identify improved methods for remediation. Improved characterization of carbon tetrachloride distribution and movement in the vadose zone is needed in the near term to make remediation decisions. Improved technologies for removing or immobilizing waste in the vadose zone and preventing its entry into the groundwater and the Columbia River will continue to be important. The Science and Technology Roadmap (DOE/RL 2000) will continue to be used to link the needs of cleanup projects to science and technology investigations.

5.1.3 Considerations for Final Protection Efforts

The character of waste in tanks at the Hanford Site remains key to protecting groundwater beneath the site. An important component of this groundwater strategies success is the development of tank retrieval technologies that will limit the loss of tank waste during retrieval operations.

For many past-practice waste sites in the Central Plateau with long-lived contaminants that are already deep in the vadose zone, the placement of covers or barriers over the site may be the only practicable action to reduce the movement of contaminants and delay their entry into groundwater. Continued research into effective methods to immobilize or remove these contaminants will be pursued. Examples of improved technology identified in the Science and Technology Roadmap (DOE/RL 2000) are six-phase heating to remediate carbon tetrachloride in the vadose zone and work to improve the performance of waste site covers.

5.2 Groundwater Monitoring

Groundwater monitoring is conducted to:

- Detect the impact to groundwater from operating and past practice waste sites
- Determine the nature and extent of groundwater contamination so appropriate action can be taken
- Assess the effectiveness of groundwater remediation activities
- Verify that Hanford contaminants are not present in offsite groundwater and monitor the groundwater adjacent to the Columbia River for Hanford contaminants. Routine surface water monitoring of the Columbia River adjacent to the Hanford Site is conducted by the Hanford Site Environmental Surveillance Program for Hanford related contaminants.
- Determine groundwater flow rate and direction

5.2.1 Groundwater Monitoring Framework

The groundwater will be monitored to support cleanup decisions and to verify that land-based disposal units are properly designed and operated to prevent impact to groundwater and to assess the effectiveness of cleanup decisions/remedial actions. Groundwater monitoring needs are defined principally by regulatory requirements of RCRA (including implementing regulations of WAC 173-303), CERCLA, and AEA and directly support agreed-upon cleanup goals. Once these monitoring needs are defined, an enforceable regulatory pathway and/or decision document under RCRA or CERCLA can be developed.

The complex nature of the various regulatory programs applicable to Hanford groundwater cleanup do not always provide a clear or intuitive pathway to achieve cleanup goals articulated in this strategy, particularly with regard to the key objective of satisfying each of the key programs through a single, integrated groundwater program. The Tri-Party agencies intend to use the groundwater monitoring and cleanup goals established in this document as a starting point, and to interpret and apply regulatory requirements, policy and guidance in a way that best supports meeting these goals. Ultimately, of course, monitoring and cleanup requirements must demonstrate compliance with applicable rules, regulations, and the Tri-Party Agreement (Ecology et al. 1998). Once developed, requirements must be reflected in enforceable decision documents.

The EPA's data quality objectives (DQO) process was successfully used to integrate the RCRA, CERCLA, and AEA groundwater monitoring requirements in the 200 West Area and will be used as a model for the remaining groundwater regions. The levels of participation by stakeholders in the DQO process will vary according to project needs. The DQO process is a seven-step decision making process that requires the user to clearly:

- Define the problem to be resolved
- Identify the decisions to be made
- Identify the inputs needed to resolve the decisions
- Define the boundaries of the study area
- Identify decision rules
- Define tolerable limits on decision error
- Identify the optimum sampling design

The success of the DQO process for 200 West Area had much to do with DOE, EPA, and Ecology being encouraged to provide input prior to beginning the DQO process, as well as throughout the process. For example, DOE, EPA, and Ecology were interviewed separately prior to beginning the DQO process to identify specific issues and concerns they wanted taken into consideration in the final sampling design. Their input was used to develop a pre-draft "straw man" DQO Summary Report. A separate meeting was held with DOE, EPA, and Ecology to introduce them to the "straw man" DQO Summary Report, and to get their preliminary feedback. This feedback was integrated into the document to develop the Draft DQO Summary Report, which was issued for comprehensive review.

Once contamination is detected, monitoring and related activities assess the nature and extent of groundwater contamination so appropriate action can be taken. Appropriate action may vary depending on the risk associated with the contamination as indicated by the mass of contaminant involved, its mobility and persistence in the environment, and its toxicity.

The following strategy provides a common, site-wide perspective to guide the development of assessment activities for individual groundwater operable units and, when appropriate, groups of waste sites. Guiding principles are developed within the context of existing groundwater conditions, the regulatory framework for remediation, and stakeholder values. These principles for a comprehensive groundwater assessment approach are summarized below:

- When a new plume/contamination is discovered within an existing plume, assessment of the new plume/contamination should be incorporated into the ongoing assessment of the existing plume as long as the cleanup goals/objectives of both are the same. For other plumes, assessment actions will be undertaken once contaminant concentrations are detected in groundwater above an agreed to threshold. Whenever possible, predictions of future conditions with reliable estimates or known inventory information will be used as a tool to locate future monitoring wells and determine future monitoring requirements.

- Monitoring and characterization of waste sites will use a graded approach, focusing resources on sites that have a large inventory of long-lived and mobile contaminants. Groundwater monitoring and characterization of contaminant plumes also will use a graded approach, focusing resources on plumes that may pose a threat to the Columbia River or groundwater. The vast majority of such contamination occurs in the 200 Areas. First priority will be given to waste sites and groundwater contaminant plumes (for example, carbon tetrachloride, single-shell tanks, specific retention trenches and cribs that received tank waste) with a known or suspected inventory of long-lived and mobile contaminants sufficient to pose a threat to the Columbia River or to affect groundwater resources outside of the 200 Areas core zone. The three groundwater plumes associated with the PUREX Plant operations (tritium, nitrate, and iodine-129) are expected to attenuate through natural processes. These plumes do not currently pose a risk to human health or the environment, and risk from these plumes is not expected to increase in the future. It is the intent of the Tri-Parties that source remedies will be employed to prevent further degradation of groundwater or contamination of groundwater under the waste site. It is the goal of this strategy to prevent 200 Area contaminants from recontaminating the aquifer outside of the 200 Area core zone. Attainment of this goal also will ensure protection of the Columbia River and its users.

- For monitoring needs of single-shell tank waste management areas and low level waste burial grounds refer to Appendix A of this document.

- When practicable, vadose zone monitoring will be considered to allow the early detection of contamination before it reaches groundwater. The applicability of vadose zone monitoring is the subject of a study that is underway.

- If contamination from a facility is detected, an evaluation will be performed to identify what needs to be done to correct the problem.

- Predictions of future conditions will be used to establish the thresholds for triggering assessments and identify the mass of contaminant that could lead to groundwater degradation.

Waste sites contributing to groundwater contamination in the core zone are likely to impact existing, partially or well-defined plumes. Assessment of existing and new sources should be undertaken in a phased manner. The first screening phase should evaluate whether the source area is likely to significantly impact the underlying plume, or whether the new source contribution is within the capability of any remediation system in place. Criteria might include:

- Mass flux from source areas compared to the mass and distribution of contaminants in the underlying plume

- Contaminants in the source area compared to the underlying plume (chemical nature, mobility)

- Capability of any containment/remediation system to accommodate releases from the source area

If the results of the first phase of investigation indicate that (1) the source area is not a significant contributor to the underlying plume or (2) any releases from the source area can be effectively addressed by existing remediation systems, then further assessment/characterization is not warranted at that site.

If results of the first phase of investigation indicate that (1) the source area is a potentially significant contributor to contamination or (2) modifications to the remediation system at the source area might be needed, then additional characterization is warranted to determine what additional remediation might be necessary. A generalized decision logic for this process is provided in Figure 2.

Land-based RCRA-regulated units that currently accept or actively manage waste are a special case. For these units, the principal monitoring goal is to demonstrate that the engineered unit is performing satisfactorily and preventing releases to the environment, rather than provide information to be used in the cleanup of past releases or existing plumes. Further, implementing Subpart F WAC 173-303-645 proscriptive groundwater monitoring requirements is less flexible than monitoring associated with cleanup. Even within this context, the groundwater monitoring locations should be evaluated to best serve the requirements of disposal unit monitoring and groundwater plume cleanup. This includes monitoring locations near potential leaks from tanks undergoing waste retrieval.

Groundwater monitoring is described in more detail in the environmental monitoring plan developed for the Hanford Site (DOE/RL 1997).

Science and Technology. Technology needs to be developed to support groundwater monitoring. Technologies that will provide improved information at lower cost can be used during the active cleanup phase and could greatly reduce the cost of monitoring during long-term stewardship. Advances will not be possible without continuing investments in science and technology.

Modeling and Assessment to Support Groundwater Monitoring. Computer modeling has long been used to assist in designing networks of groundwater monitoring wells. Models have included complex, site-wide groundwater models to identify where and when contaminants might reach the point of compliance or point of concern so that monitoring wells can be located with the best chance of detecting the first arrival of contamination and of monitoring the movement of any plumes. Computer models also have included the aquifer hydraulic model, which predicts water-table elevation and is used to identify wells that require deepening or replacement because of water-level change. Water-level change occurs when liquid disposal practices change in the core zone. As cleanup proceeds, modeling will continue to identify locations where monitoring is needed to detect and monitor plumes and to reduce uncertainty in the area between wells where measurements are not available.

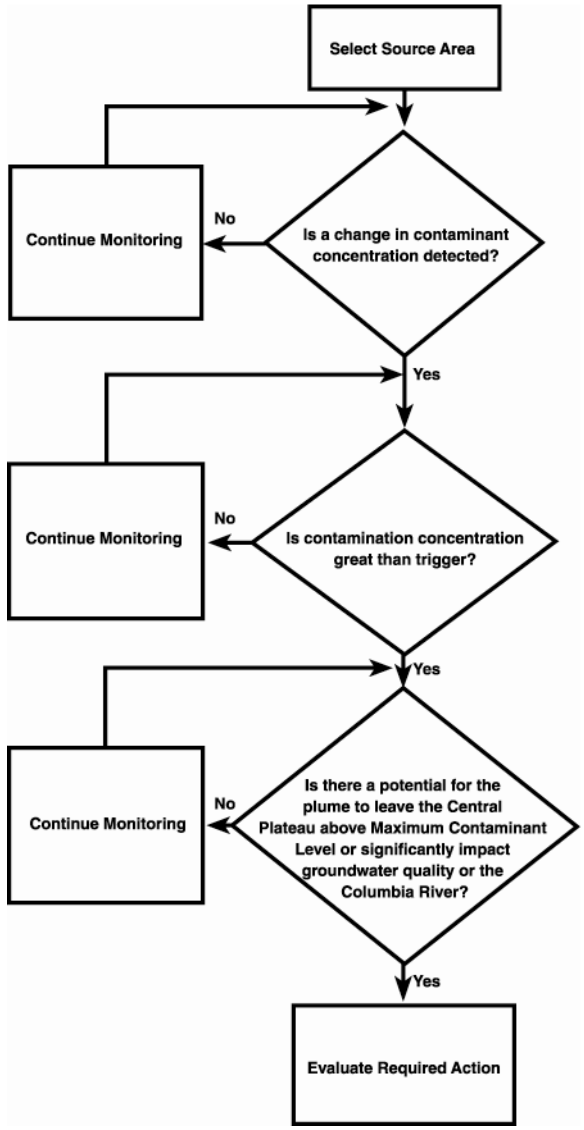

Figure 2. Generalized decision logic for assessment and remediation of groundwater

5.2.2 Considerations for Near-Term Action

The Hanford Site currently has an extensive groundwater monitoring program with results reported each year, most recently in *Hanford Site Groundwater Monitoring for Fiscal Year 2002* (Hartman et al. 2003). The Tri-Parties have identified a number of near-term actions to improve the integration of monitoring performed to meet a number of site needs. Those actions include:

- Carry out the data quality objectives process for the core zone to coordinate and possibly integrate RCRA, CERCLA and AEA requirements

- Examine the decision road map for the core zone to identify additional information needs that require monitoring

- Develop a prioritized rolling 3-year schedule for monitoring well installation

- Establish a process to review and update the monitoring program

5.2.3 Considerations for Final Monitoring Efforts

As the cleanup continues to reduce the potential for waste sites and site operations to affect groundwater, the Tri-Parties will continue to implement the process developed to review and update the groundwater monitoring program. Once protective measures and remedial actions are completed that are protective of public health and the environment, contamination may be left in the vadose zone and the groundwater. Therefore, adequate monitoring must continue, not only of the groundwater and vadose zone but also for the soundness of physical barriers and institutional controls that continue into the future. Figure 2 shows the decision process that would lead to initiating new or further cleanup now and in the future. In addition, the records of decision are and will be reviewed every 5 years to identify when additional actions are needed.

5.3 Groundwater Remediation

The goal of groundwater remediation is to restore groundwater to its intended beneficial use to protect human health, the environment, and the Columbia River.[2] This strategy provides a common, site-wide perspective to guide the development of remediation activities for individual operable units. Guiding principles are developed within the context of existing groundwater conditions, the institutional and regulatory framework for remediation, and stakeholder values. These principles of a comprehensive groundwater remediation approach are summarized below.

The remediation strategy is a geographic and plume-specific approach to groundwater remediation. The following are key elements of this strategy:

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[2] As a regulatory requirement and policy objective in both the RCRA and CERCLA programs "EPA expects to return usable ground waters to their beneficial uses wherever practicable, within a time frame that is reasonable given the particular circumstances of the site. When restoration of groundwater to beneficial uses is not practicable, EPA expects to prevent further migration of the plume, prevent exposure to the contaminated ground water and evaluate further risk reduction." – 40 CFR 300.430(a)(1)(iii)(F)

- Place a high priority on actions that protect the Columbia River and near-shore environment from degradation caused by the inflow of contaminated groundwater

- Reduce the contamination entering the groundwater from existing sources

- Control the migration of plumes that threaten or continue to further degrade groundwater quality beyond the boundaries of the core zone

- Avoid recontamination of the sites undergoing groundwater remediation or further groundwater degradation from site operations

- Establish alternate concentration limits when required to attain cleanup goals according to applicable regulations.

5.3.1 Groundwater Remediation Framework

Characterization. The necessary characterization will be carried out to better understand the hydrogeology, contaminant behavior/chemistry, sub-surface conceptual model, contaminant inventory and its nature and extent, and to design and assess remedial actions where ever appropriate. Modeling results will be validated with actual field data. The field site will provide an opportunity to test advanced characterization tools and methods, identify mechanisms and processes that control the depth and extent of contaminant plumes in the Hanford vadose zone, and calibrate and refine predictive transport model.

As new information is obtained, estimates of actual or potential exposure and the associated effect on human health and the environment may be refined throughout the remedial investigation. Therefore, site characterization activities will be fully integrated with the development and evaluation of alternatives in the feasibility study/remediation effort.

Risk Assessment. Remedial alternatives/goals will establish acceptable exposure levels that protect human health and the environment. These alternatives will be developed under applicable and appropriate requirements in federal and state laws. Risk assessment will follow the CERCLA protocol set for different site-use scenarios. For the framework affecting the scenarios, see Appendix C. Detailed assessment may include a number of site-specific land-use scenarios ranging from unrestricted, agricultural, tribal, and restricted scenarios such as industrial use. The assessment also may include quantification of the cumulative health and environmental effect of Hanford contaminants on ecology and human health. Other considerations may include culture and economy of the area. The goal is to meet the required cleanup levels for groundwater through remediation and other appropriate measures.

Science and Technology. Science and technology are needed long term to support groundwater remediation on the Hanford Site. In some cases, existing technologies are prohibitively expensive for long-term use and in other cases the knowledge and technology needed to address the problem does not yet exist.

Modeling and Assessment to Support Groundwater Remediation. Predictions of future movement of contaminants in groundwater play an important role in prioritizing, planning, and evaluating the effectiveness of remediation actions. Models of the vadose zone and groundwater for individual waste sites are used to plan barrier location and size as well as design pump-and-treat systems and other remedies. Models representing multiple waste sites are used to help identify locations (for example, B/C cribs and trenches, each tank within an individual tank farm, or multiple tank farms within an operational area, like all within 200 West Area) where active remediation will achieve the greatest benefit. Models used will be validated against real data to ensure accuracy.

5.3.2 Initial Remediation Efforts

Groundwater remediation efforts are underway at the Hanford Site. These efforts:

- Maintain a bias toward field remediation activities by employing the Hanford Past Practice Strategy (DOE 1991) to accelerate interim remedial actions
- Continue to implement accelerated groundwater remediation projects to control plume expansion, reduce contaminant mass, and better characterize aquifer response to remedial actions
- Develop and evaluate alternative remediation technologies

A number of characterization and assessment actions are underway at the Hanford Site to provide important data to evaluate and support remediation decisions. These actions will be completed prior to initiating any new actions in the same study area. Evaluation and update of existing groundwater remediation actions will continue under past-practice authority using interim records of decision that may be modified to accommodate new remediation technologies and characterization needs. Ongoing characterization actions for tank farms (supporting the field investigation reports) will be completed prior to revising the monitoring/assessment well networks for the corresponding waste management area.

Continued technology development is needed to identify alternate, more effective remediation techniques for existing groundwater contaminant plumes. Techniques to remove, remediate, and/or immobilize chromium, uranium, and technetium-99 in the vadose zone before reaching groundwater; techniques to reduce costs for existing remediation technologies; and characterization to understand natural degradation of carbon tetrachloride are examples of near-term science and technology needs. The science and technology roadmap (DOE/RL 2000) will continue to be used to link cleanup project needs to science and technology investigations.

5.3.3 Final Remediation Efforts

Succeeding phases of remedial actions are oriented toward identifying and implementing the final record(s) of decision, which in turn will satisfy broader cleanup objectives, such as:

- Achieve applicable relevant and appropriate requirements with respect to the value of current and potential future beneficial uses for the groundwater resource
- Develop alternative containment and remediation strategies if currently available groundwater restoration technologies prove inadequate or impracticable

- Restore groundwater outside the core zone for unrestricted use as soon as technically possible

- Remediate groundwater in the river corridor with the focus on protecting human health and the environment

- Prevent further degradation of groundwater quality beyond the boundaries of the core zone and ultimately restore unrestricted use of groundwater beyond that boundary. It is the intent of the Tri-Parties that source remedies will be employed to prevent further degradation of groundwater or contamination of groundwater under the waste sites.

- Implement process to establish alternate concentration limits (ACLs) where required

5.3.4 Resource Optimization

An important element in the groundwater remediation strategy is optimizing the use of available resources. The following are key considerations:

- Balance the sequencing and scale of remedial actions to achieve efficient use of resources

- Incorporate existing and/or proposed treatment and disposal infrastructure

- Implement currently available technology and foster demonstrations of developing technology for meeting remediation objectives

- Improve the integration of the existing groundwater monitoring networks and sampling schedules to better characterize the contamination problem and to measure the effectiveness of remediation efforts

- Obtain information necessary to make decisions and speed up remediation of groundwater

- DOE will review DOE Orders to ensure they are relevant to the cleanup mission

5.3.5 Remediation of Emerging Groundwater Plumes

EPA, DOE, and Ecology recognize the need to coordinate the application of regulatory requirements and that past-practice authority may provide the most efficient means for addressing mixed-waste groundwater contamination plumes originating from a combination of treatment storage and disposal units (TSD) and past-practice units. However, in order to ensure that TSD units within the operable units are brought into compliance with RCRA and State hazardous waste regulations, Ecology intends that all response or corrective actions, excluding situations where there is an imminent threat to the public health or environment will be conducted in a manner which ensures compliance with the technical requirements of the HWMA (Chapter 70.105 RCW and its implementation regulations). In any case, the parties agree that CERCLA remedial actions and, as appropriate, HSWA corrective measures will comply with applicable or relevant and appropriate requirements (ARARs) (Ecology et. al. 1998, Section 5.3.5).

6.0 Implementation

This document presents the strategy for groundwater protection, monitoring, and remediation. To implement this strategy, the Tri-Parties will: (1) outline the details of specific groundwater protection, monitoring, and remediation actions in technical and regulatory documents and (2) communicate the plans and results to Tribal governments, stakeholders, and the public.

6.1 Implementing Documents

This document identifies the strategy for groundwater protection, monitoring, and remediation for the Hanford Site. As such, this document is not intended to provide the details of how DOE will protect, monitor, and remediate the groundwater, nor is it intended to be legally binding on the Tri-Parties. Specific actions necessary to implement the strategy will be carried out through individual decision documents and several subordinate policy level documents.

The Tri-Party Agreement (Ecology et al. 1998) is the primary legal document that provides schedules and requirements to achieve compliance with applicable regulatory requirements and to clean up the Hanford Site. Generally, the Tri-Party Agreement relies on program-specific decision documents, such as the RCRA site-wide permit and CERCLA decision documents (including 5-year reviews of records of decision) to develop and approve work necessary to implement this strategy and satisfy regulatory requirements. In other instances, such as where waste management units cannot operate in compliance with applicable regulatory standards (for example, single-shell tanks), the Tri-Party Agreement defines schedules of specific actions necessary to achieve compliance and mitigate the effects of non-compliant activities. In all cases, specific requirements that implement this groundwater strategy will be subject to public notice and comment according to the program-specific administrative approval requirements associated with each decision document or the Tri-Party Agreement.

The following strategy/plan documents provide additional strategy, policy or procedures that relate to the overall strategy of this document:

- *Hanford's Groundwater Management Plan: Accelerated Cleanup and Protection* (DOE/RL 2003)
- Groundwater remediation strategy (DOE/RL 1995)
- Annual project planning process carried out each year
- Groundwater monitoring plans such as *FY 2002 Integrated Monitoring Plan for the Hanford Groundwater Monitoring Project* (Hartman et al. 2001)
- *Hanford Site Groundwater Monitoring Setting, Sources and Methods* (Hartman 1999)
- Hanford Site groundwater monitoring reports, for example, *Hanford Site Groundwater Monitoring for Fiscal Year 2002* (Hartman et al. 2003)

- Central Plateau wide study (presently underway) of the vadose zone to provide guidance on when vadose zone monitoring is appropriate

Strategies set forth in this document and the various supporting strategy/policy documents enumerated above may be reflected as appropriate in final enforceable decision documents and Tri-Party Agreement milestones and requirements. The Tri-Parties will review this strategy annually to determine if it remains consistent with their long-range goals.

6.2 Communicating Plans, Progress, and Results

The Tri-Parties recognize the importance of communicating the plans and results of groundwater actions to Tribal governments, stakeholders, and the public. Transparency and accessibility lead to more effective public participation in protecting, monitoring, and remediating Hanford groundwater. Improved understanding of the issues, challenges, and options will lead to better decisions and to credibility for the agencies responsible for making those decisions.

The communication strategy to support these goals will involve the use of a diverse range of activities and products to provide information to and elicit input from these organizations and individuals about Hanford groundwater actions. Examples of communication mechanisms that may be used are regular public meetings, internet-accessible information, articles in general and technical publications, electronic newsletters, and informational compact discs. Specific detailed communication planning is included in *Hanford's Groundwater Management Plan: Accelerated Cleanup and Protection* (DOE/RL 2003) and will be included DOE's communication plan which is under development.

7.0 References

40 CFR 264. U.S. Environmental Protection Agency. "Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities." *U.S. Code of Federal Regulations.*

40 CFR 265. U.S. Environmental Protection Agency. "Interim Status Standards for Owners of Hazardous Waste Treatment, Storage, and Disposal Facilities." *U.S. Code of Federal Regulations.*

40 CFR 300. U.S. Environmental Protection Agency. "National Oil and Hazardous Substances Pollution Contingency Plan." *U.S. Code of Federal Regulations.*

AEA - Atomic Energy Act. 1954. Public Law 83-703, as amended, 68 Stat. 919, 42 USC 2011 et seq.

CERCLA – Comprehensive Environmental Response, Compensation, and Liability Act. 1980. Public Law 96-150, as amended, 94 Stat. 2767, 42 USC 9601 et seq.

DOE Order 435.1. 1999. *Radioactive Waste Management*. U.S. Department of Energy, Washington, D.C. Available on the Internet at http://www.directives.doe.gov/pdfs/doe/doetext/neword/435/o4351.pdf.

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DOE/RL. 1995. *Hanford Site Groundwater Remediation Strategy*. DOE/RL-94-95, Rev. 1, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

DOE/RL. 1997. *Environmental Monitoring Plan, United States Department of Energy, Richland Operations Office*. DOE/RL-91-50, Rev. 2, prepared by Pacific Northwest National Laboratory, Fluor Daniel Hanford, Inc. and its subcontractor Waste Management Federal Services of Hanford, Inc., and Bechtel Hanford, Inc. for the U.S. Department of Energy, Richland Operations Office, Richland, Washington. Available on the Internet at https://www.osti.gov/dublincore/doeecd/servlets/purl/584921-ppL6fQ/webviewable/.

DOE/RL. 1991. *Hanford Past Practice Strategy*. DOE/RL-91-40, Rev. 0, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

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DOE/RL. 2003. *Hanford's Groundwater Management Plan: Accelerated Cleanup and Protection*. DOE/RL-2002-68, U.S. Department of Energy, Richland Operations Office, U.S. Department of Energy, Office of River Protection, Richland, Washington.

Ecology - Washington State Department of Ecology, U.S. Environmental Protection Agency, and U.S. Department of Energy. 1998. *Hanford Federal Facility Agreement and Consent Order*. Document No. 89-10, Rev. 5 (The Tri-Party Agreement), Olympia, Washington.

Hanford Future Site Use Working Group. 1992. *The Final Report of the Hanford Future Site Use Group*. Richland, Washington.

Hartman, M.J. (ed.). 1999. *Hanford Site Groundwater: Settings, Sources, and Methods*. PNNL-13080, Pacific Northwest National Laboratory, Richland, Washington.

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Hartman, M.J., P.E. Dresel, J.W. Lindberg, D.R. Newcomer, and E.C. Thornton. 2001. *FY 2002 Integrated Monitoring Plan for the Hanford Groundwater Monitoring Project*. PNNL-13698, Pacific Northwest National Laboratory, Richland, Washington.

RCRA – Resource Conservation and Recovery Act. 1976. Public Law 94-580, as amended, 90 Stat. 2795, 42 USC 6901 et seq.

RCW 70.105. *Hazardous Waste Cleanup—Model Toxics Control Act*. Revised Code of Washington, Olympia, Washington.

WAC 173-303. *Dangerous Waste Regulation*s. Washington Administrative Code, Olympia, Washington.

WAC 173-340. *Model Toxics Control Act*. Washington Administrative Code, Olympia Washington.

WAC 173-303-645. *Releases from Regulated Units*. Washington Administrative Code, Olympia, Washington.

WAC 173-303-646. *Corrective Action*. Washington Administrative Code, Olympia, Washington.

WAC 173-303-800. *Permit Requirements for Dangerous Waste Management Facilities*. Washington Administrative Code, Olympia, Washington.

Appendix A

Role of RCRA Corrective Action for Groundwater: Additional Regulatory Background Information

Appendix A

Role of RCRA Corrective Action for Groundwater: Additional Regulatory Background Information

The Resource Conservation and Recovery Act (RCRA)[3] and Washington State Dangerous Waste Programs have two key corrective action programs relating to clean up of releases to the environment. The first, and more traditional, relates to releases to groundwater from land-based "regulated units," defined in WAC 173-303-040 such as landfills, land treatment units, surface impoundments and waste piles. This program element, which is an integral part of required groundwater monitoring under 40 CFR 264, Subpart F, and WAC 173-303-645, is limited to releases to groundwater from these specific types of units. This authority does not apply to other types of units or to releases to any other environmental media.

In re-authorizing RCRA in 1984 through the Hazardous and Solid Waste Act amendments, Congress added the second corrective action program element, now more broadly known as the RCRA corrective action program. This authority has several notable elements. First, it is statutorily required of all permitted facilities to protect human health and the environment. Second, it applies to solid waste management units, a scope well beyond the limited applicability of 40 CFR 264, Subpart F, groundwater corrective action. Third, it applies to releases to all media, not just releases to groundwater. Finally, it may be satisfied by specific permit conditions or by schedules of compliance where necessary work cannot be completed by the time of issuance of the permit.

How do these two corrective action program elements relate to one another? Generally, releases to groundwater from "regulated units" (in the 40 CFR 264, Subpart F, context) must be addressed through the groundwater monitoring requirements of Subpart F and WAC 173-303-645. Because these types of releases are most closely associated with the waste management component of RCRA, the choice between the applicable Subpart F and the Hazardous and Solid Waste Act corrective action requirements is strongly biased to the preventive waste management standards of 40 CFR 264, Subpart F. The one key exception to this interpretation is land-based units that are closed or closing and subject to post-closure care requirements. In this instance, the groundwater monitoring requirements of 40 CFR 264, Subpart F, and WAC 173-303-645 may be replaced with equally protective requirements developed through the Hazardous and Solid Waste Act corrective action process.

Under terms of the Hanford Tri-Party Agreement (Ecology et al. 1998), cleanup responsibilities are allocated to the authorities of RCRA and the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) with oversight by the U.S. Environmental Protection Agency (EPA) and

[3] However, because RCRA applies only to "solid wastes" which are defined to exclude "radioactive source, special nuclear and by product materials" the corrective action and subpart F requirements only apply to the non-radioactive constituents. Any remediation of these radionuclides must be done pursuant to the authority of the Atomic Energy Act or CERCLA.

Washington State Department of Ecology (Ecology). In a number of instances, both agencies and both programs have jurisdiction over the same waste management unit. A specific example is a solid waste management unit subject to corrective action under WAC 173-303-646 and under the cleanup authorities of CERCLA. The clear intent of both the Tri-Party Agreement and the site-wide permit is to minimize duplication and overlap of regulatory activities while ensuring full compliance with applicable requirements.

Where particular corrective action conditions under the authority of WAC 173-303-646 are not explicitly included in the site-wide permit (either condition II.Y.3 or Part IV), permit condition II.Y.2 addresses this question of overlapping jurisdiction. Generally, this condition recognizes and accepts as potentially satisfying the corrective action requirements of WAC 173-303-646 work completed (including schedules of compliance) under the Tri-Party Agreement for both CERCLA and RCRA past-practice units. This condition requires the permittee to comply with the terms and schedules in the Tri-Party Agreement for each of these units. Permit conditions II.Y.2.a and II.Y.2.b accomplish this end by including Tri-Party Agreement requirements and schedules applicable to CERCLA and RCRA past-practice units into the site-wide permit by reference, including amendments to the Tri-Party Agreement after the effective date of these permit conditions. As documents developed and approved under the Tri-Party Agreement, CERCLA records of decision also are included in this provision as documents developed and approved under the Tri-Party Agreement. In this way, the permit explicitly exercises and satisfies the corrective action requirements of WAC 173-303-646 while fully meeting the objective of minimizing or elimination duplication and overlap between programs and agencies. In no way does this mechanism waive or provide any relief from any applicable RCRA or CERCLA requirement.

Permit condition II.Y.2.c also recognizes the overlap between the RCRA closure/postclosure requirements and corrective actions. This condition allows the permittee to satisfy applicable corrective action requirements through the closure/post-closure care process. Although both EPA and Ecology policy and guidance acknowledge that closure and corrective action should achieve similar environmental outcomes, this condition anticipates that the RCRA closure process should be the principal regulatory mechanism for dealing with environmental releases at the time of unit closure.

A.1 Summary of Unit Classifications at Hanford

Units at the Hanford Site subject to groundwater monitoring requirements can be divided into several general classes. The first includes land-based units currently operating and receiving regulated dangerous/mixed waste. For these units, the primary regulatory focus is the preventive waste management component of RCRA, specifically the traditional detection/compliance monitoring and groundwater corrective action requirements of WAC 173-303-645. Presently, units in this class include the mixed waste trenches 31 and 34, the Liquid Effluent Retention Basins, and through the CERCLA program, the Environmental Restoration Disposal Facility. These units all have, or are scheduled to receive, RCRA operating permits (or CERCLA authorization in the case of the Environmental Restoration Disposal Facility). As waste management units, this class of regulated units is expected to be well designed, constructed, and operated to prevent releases to the environment, including groundwater, that require cleanup.

The second class includes closed/closing land-based units that are identified as RCRA treatment, storage, and disposal units in Appendix B of the Tri-Party Agreement (Ecology et al. 1998) but are no longer actively receiving regulated waste. This class of units includes traditional landfills or burial grounds[4] as well as other units like cribs or trenches. These units are scheduled to begin the closure/post-closure process and will not receive RCRA operating permits. These units also are subject to the traditional groundwater monitoring requirements of WAC 173-303-645 but may also be eligible for provisions that allow groundwater and closure requirements to be developed through the corrective action process under the authority of WAC 173-303-645(1)(e). When this regulatory provision can be applied,[5] it is possible to satisfy applicable RCRA regulatory requirements for the regulated unit through equally protective requirements developed under CERCLA authority.

The third class of units includes single-shell tanks. Single-shell tanks are not regulated as land-based units under WAC 173-303-645 (see specifically the definition of "regulated unit" in WAC 173-303-040), although contaminated soil associated with single-shell tanks may require closure as a landfill under the tank closure requirements of WAC 173-303-640(8)(b)[6]. Rather, single-shell tanks are non-compliant tank systems that cannot receive operating permits for storage of dangerous/mixed waste. As such, these units are addressed by compliance requirements and schedules of Tri-Party Agreement milestone M-45, including retrieval of waste and the development and implementation of closure plans.[7] Due to the special regulatory status of single-shell tanks , all groundwater monitoring and response actions should be within the integrated, long-term management approach set forth in Tri-Party Agreement milestones M-45 and the associated monitoring requirements of M-24.

The final class of units are RCRA and CERCLA past-practice units scheduled under the Tri-Party Agreement Appendix C to be addressed under the CERCLA or RCRA corrective action process. RCRA and CERCLA achieve similar environmental endpoints with respect to protecting groundwater. Therefore, it may be appropriate for corrective action decisions at RCRA past-practice units to defer the groundwater component of a cleanup to a CERCLA operable unit, or to accept work conducted under CERCLA authority as satisfying RCRA corrective action requirements. This latter mechanism is fully developed as part of RCRA site-wide permit condition II.Y.2.

A.2 Single-Shell Tank Site Characterization and Monitoring

Single-shell tanks are non-compliant tank systems that, for many technical reasons, cannot be removed from service at this time. Tri-Party Agreement milestones associated with single-shell tanks

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[4] Only the portions of these units that received mixed waste, i.e., not all burial grounds, just those that received waste after July 1987 for mixed waste.

[5] Other applicability criteria include (1) a demonstration that the regulated unit is situated among other solid waste management units or areas of concern, (2) a release has occurred, and (3) both the regulated unit and one or more of the solid waste management units or areas of concern are likely to have contributed to the release. In addition, it is not necessary to apply the traditional groundwater monitoring and closure requirements in order to protect human health and the environment. See specifically WAC 173-303-645(e)(i) and (ii).

[6] As noted earlier, RCRA does not apply to the radioactive components of radioactive mixed waste. Therefore, permit conditions do not provide a mechanism to address radioactive contaminants.

[7] Formal approval of closure plans will be under the permit modification authority of WAC 173-303-800, pursuant to requirements of the TPA Action Plan Section 5.3.

provide a schedule of compliance for these tanks, including specific measures such as groundwater monitoring requirements that are necessary to minimize the environmental harm of continued management of waste in single-shell tanks and to build the necessary technical database to support retrieval and closure. The single-shell tanks are addressed by compliance requirements and schedules of Tri-Party Agreement milestones (for example, M23, M41, M44, M45) that include actions on the retrieval of waste, development and implementation of RCRA corrective actions, closure plans, and post-closure monitoring. The single-shell tank monitoring would, therefore, include both vadose zone and groundwater characterization to detect contaminant sources in the vadose zone and groundwater and to delineate the nature of extent of contamination in both media so the necessary data needs are met to support waste retrieval, RCRA corrective actions, closure and post-closure monitoring. These activities will be carried out though various Tri-Party Agreement milestones as discussed in the preceding paragraphs. Wherever feasible, the characterization, monitoring, and corrective actions will be integrated on a site-wide basis to benefit other programs (for example, CERCLA) and to provide cost efficiencies.

A.3 Low Level Burial Grounds

Ecology and EPA recognize that the low-level burial grounds (LLBG) contain both active waste management units and inactive past-practice units. Consistent with policies articulated in the Groundwater Strategy, Ecology intends to permit the active regulated portions of the LLBG to prevent an adverse impact to the environment from waste management operations, and to monitor operations (including groundwater monitoring) to verify that an adverse environmental effect does not occur from waste management operations. Ecology, the U.S. Department of Energy, and contractors are currently engaged in reviewing the permit modification request for LLBG, specifically including groundwater monitoring requirements that will be included in the draft permit modification. Ecology intends to develop draft permit conditions for groundwater monitoring that satisfy requirements of WAC 173-303 consistent with the policies established in the groundwater strategy document.

With respect to addressing inactive past-practice units within the LLBG, Ecology and EPA intend to require groundwater monitoring as necessary to evaluate the environmental impact from past-practice waste management activities according to the Tri-Party Agreement processes established under RCRA and CERCLA authority for managing past-practice units. Further, EPA and Ecology intend to apply the integration model discussed in the groundwater strategy in crafting a groundwater monitoring network for the LLBG past-practice units. As noted in the groundwater strategy, the strategy does not establish particular monitoring requirements for the LLBG or any other waste management units but does establish policies and objectives that the parties may incorporate into the applicable RCRA and CERCLA decision documents.

A.4 References

40 CFR 264, Subpart F. U.S. Environmental Protection Agency. “Releases from Solid Waste Management Units.” *U.S. Code of Federal Regulations.*

CERCLA – Comprehensive Environmental Response, Compensation, and Liability Act. 1980. Public law 96-150, as amended, 94 Stat. 2767, 42 USC 9601 et seq.

Ecology - Washington State Department of Ecology, U.S. Environmental Protection Agency, and U.S. Department of Energy. 1998. *Hanford Federal Facility Agreement and Consent Order*. Document No. 89-10, Rev. 5 (The Tri-Party Agreement), Olympia, Washington.

Hazardous and Solid Waste Amendments of 1984. 42 USC. § 6924 et seq.; 40 CFR. § 260.1 et seq. and 40 CFR. § 280.10 et seq.

RCRA – Resource Conservation and Recovery Act. 1976. Public Law 94-580, as amended, 90 Stat. 2795, 42 USC 6901 et seq.

WAC 173-303-040. *Definitions*. Washington Administrative Code, Olympia, Washington.

WAC 173-303-645. *Releases from Regulated Units*. Washington Administrative Code, Olympia, Washington.

WAC 173-303-646. *Corrective Action*. Washington Administrative Code, Olympia, Washington.

WAC 173-303-800. *Permit Requirements for Dangerous Waste Management Facilities*. Washington Administrative Code, Olympia, Washington.

Appendix B

Supplemental Information Developed in Support of the Groundwater Strategy

Appendix B

Supplemental Information Developed in Support of the Groundwater Strategy

Basis of Agreement

The U.S. Department of Energy (DOE), U.S. Environmental Protection Agency (EPA) and the Washington State Department of Ecology (Ecology)--the Tri-Parties--have noted a number of areas of agreement that provide a basis to develop a groundwater strategy:

1. The Tri-Parties desire to achieve a durable agreement with common values that will allow for further planning.

2. The Tri-Parties recognize that monitoring for the Resource Conservation and Recovery Act (RCRA) and Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) are different (management of active waste facilities and cleanup of waste facilities). The shared goal is to develop plans and schedules to install the optimal number of new wells for groundwater monitoring. This recognizes that a variety of wells (shallow and deep) will be needed.

3. Problems need to be approached in a fresh way.

4. Establishing a sufficient monitoring network or networks will be a multi- year effort. The Tri-Parties need to agree on appropriate criteria for prioritization.

5. Prioritization must be implemented across the three statutes (RCRA, CERCLA, and the Atomic Energy Act of 1954).

6. The extensive groundwater contaminant plumes of tritium, nitrate, and iodine-129 have resulted from past-practice discharges to the soil at cribs, ponds, and ditches. These discharges were generally high-volume and of relatively low concentration. However, there is relatively little inventory that remains in the vadose zone that is long-lived and mobile and could contribute to additional groundwater contamination in the future. It is assumed that most of the liquids discharged to the soil have drained, and the soil at these sites may be approaching field capacity. Characterization will be needed prior to site closure to confirm this.

7. Further investigations and additional monitoring are required to deal with the carbon tetrachloride plume.

8. Current remedial actions need to focus on carbon tetrachloride, chromium, strontium-90 (100-N Area), technetium-99, and uranium. As other contaminant plumes are discovered, they will be prioritized.

9. Carbon tetrachloride characterization is less mature than the other contaminants listed in item 8.

10. A large inventory of long-lived and mobile contaminants in the vadose zone from past leaks at single-shell tanks, overflow from tanks to cribs, and in specific retention trenches where tank waste was disposed to the soil is likely. It is assumed that long-lived and mobile contaminants in the vadose zone have or will impact groundwater in the future. Characterization data and detection monitoring are both important for the single-shell tank sites.

11. The design for new groundwater monitoring wells needs to anticipate the dynamics of the aquifer. In some areas, existing monitoring wells are going dry and the direction of groundwater is changing. The significant inventory of mobile and long-lived contaminants, dropping water level, and dynamics in flow directions and rates justify upgrades to the monitoring system.

12. Opportunities exist for cost efficiencies in the areas of investigation-derived waste management, purge water management, sampling schedules, number of contaminants, and statistical approaches.

13. The impact of discharges from septic systems on contaminant movement in the vadose zone and on groundwater flow needs to be better understood.

B. References

Atomic Energy Act of 1954. 1954. Public Law 83-703, as amended, 68 Stat. 919, 42 USC 2011 et seq.

CERCLA – Comprehensive Environmental Response, Compensation, and Liability Act. 1980. Public law 96-150, as amended, 94 Stat. 2767, 42 USC 9601 et seq.

RCRA – Resource Conservation and Recovery Act. 1976. Public Law 94-580, as amended, 90 Stat. 2795, 42 USC 6901 et seq.

Appendix C

Letter to the Hanford Advisory Board on Exposure Scenarios for the 200 Areas

02-HAB-0006 JUL 1 1 2002

Mr. Todd Martin, Chair
Hanford Advisory Board
1933 Jadwin Avenue, Suite 135
Richland, Washington 99352

Dear Mr. Martin:

CONSENSUS ADVICE #132: EXPOSURE SCENARIOS TASK FORCE ON THE 200 AREA

This is in response to your advice #132 dated June 7, 2002, regarding the Central Plateau risk framework and exposure scenario development.

The three agencies appreciate the effort the Board has undertaken to provide us with advice as we enter this critical phase of remediation and closure of Hanford's Central Plateau. Your advice, combined with the input we received from Tribal Nations and interested citizens, provided us with the guidance we needed to develop a credible exposure scenario for the Central Plateau.

We believe that the risk framework delineated in the attachment to this letter adheres closely to your advice. In the cases of minor departure, the agencies considered your advice and made the decisions to deviate based on technical and logistical factors. The inclusion of S-Ponds and B-Pond in the core zone was based on the following: the need to expand the core zone to include the footprint of the Waste Treatment Plant (Vitrification Plant), and the need to avoid splitting waste sites of anticipated similar closure strategies. Notwithstanding such a deviation, the agencies fully support the notion of evaluating the possibility of shrinking the core zone. We support your advice to maximize the potential for beneficial uses in the core zone. The potential for extended human activities in the core zone would provide an added advantage of maintaining the knowledge of the waste left in the core zone after the remedial actions are completed.

We intend to fully integrate the decisions for the remediation of the source units with those for the remediation of groundwater using the appropriate regulatory process. Establishing points of compliance and remedial objectives will be done in adherence regulations. Also, we have started an effort to evaluate groundwater technologies necessary to deploy to remediate groundwater in the core zone. This effort will be advanced through the regulatory documents and reviews of the corresponding groundwater operable units.

One of the major missions the three agencies have embarked on is the coordination of the risk assessment efforts on the Central Plateau to maintain consistency in the standards used across the site, including data collection, accurate inventory, and land use assumptions.

The U.S. Department of Energy is developing a Long-Term Stewardship (LTS) Plan for the Hanford Site. The recommendation for the creation of a "coalition of groups, to include the Tribes, local government, and other affected entities" to administer the LTS responsibilities of the site should be discussed and evaluated within the context of developing the site LTS Plan. We welcome any proposals from the Board to start such a discussion and evaluation.

We reiterate our appreciation for the work you have done to support the risk framework. If you need further information or assistance, please contact the U.S. Department of Energy, Richland Operations Office, Public Involvement Manager, Yvonne Sherman on (509) 376-6216.

Keith A. Klein, Manager
U.S. Department of Energy
Richland Operations Office

David R. Einan
Acting Hanford Project Manager
U.S. Environmental Protection Agency

Michael A. Wilson, Program Manager
State of Washington Department of Ecology

IPI:YS

Attachment

cc:
P. Mabie, EnviroIssues
M. Crosland, EM-11

U.S. Senators (OR)
Gordon H. Smith
Ron Wyden

U.S. Representative (OR)
Earl Blumenauer
Peter DeFazio
Darlene Hooley
Greg Walden

State Senators (WA)
Pat Hale
Mike Hewitt

U.S. Senator (WA)
Maria Cantwell
Patty Murray

U.S. Representative (WA)
Norm Dicks
Jennifer Dunn
Richard Hastings
George Nethercutt

Decision Strategy (Risk & Regulatory Framework)

Risk Framework Description (Tri-Party Agreement):

1. The Core Zone (200 Areas including B Pond (main pond), and S Ponds) will have an Industrial Scenario for the foreseeable future.
2. The Core Zone will be remediated and closed allowing for "other uses" consistent with an industrial scenario (environmental industries) that will maintain active human presence in this area, which in turn will enhance the ability to maintain the institutional knowledge of the wastes left in place for the future generations. Exposure scenarios used for this zone should include a reasonable maximum exposure to a worker/day user, to possible Native American users, and to intruders.
3. DOE will follow the required regulatory processes for groundwater remediation (including public participation) to establish the points of compliance and remedial action objectives. It is anticipated that groundwater contamination under the Core Zone will preclude beneficial use for the foreseeable future, which is at least the period of waste management and institutional controls (150 years). It is assumed that the tritium and iodine-129 plumes beyond the Core Zone boundary will exceed the drinking water standards for the period of the next 150 to 300 years (less for the tritium plume). It is expected that other groundwater contaminates will remain below, or be restored to drinking water levels outside the Core Zone.
4. No drilling for water use or otherwise will be allowed in the Core Zone. An intruder scenario will be calculated for in assessing the risk to human health and environment.
5. Waste Sites outside the Core Zone but within the Central Plateau (200 N, Gable Mountain Pound, B/C Crib Controlled Area) will be remediated and closed based on an evaluation of multiple land use scenarios to optimize land use, institutional control cost, and long term stewardship.
6. An Industrial land us scenario will set cleanup levels on the Central Plateau. Other scenarios (e.g., residential, recreational) may be used for comparison purposes to support decision making especially for:
    - The post-institutional controls period (>150 years).
    - Sites near the Core Zone perimeter to analyze opportunities to "shrink the site".
    - Early (precedent-setting) closure/remediation decisions.

7. This framework does not deal with the tank retrieval decision.

June 7, 2002

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Tom Fitzsimmons, Director
Washington State Department of Ecology
P.O. Box 47600
Olympia, WA 98504-7600

Subject: Exposure Scenarios Task Force on the 200 Area

Dear Mssrs. Klein, Boston, Iani, and Fitzsimmons,

The Exposure Scenarios Task Force was formed by the Tri-Party Agreement (TPA) agencies to provide them with a broad range of stakeholder values specific to the development of exposure scenarios and risk analyses to support future cleanup decisions. As a secondary product, the Hanford Advisory Board (Board) members on this Task Force were asked to develop advice for the TPA agencies covering the risk framework for the 200 Area.

The Board acknowledges that some waste will remain in the core zone when this cleanup effort is complete. However, the core zone should be as small as possible and should not include contaminated areas outside the 200 Area fences. The waste within the core zone should be stored and managed to make it inaccessible to inadvertent intruding humans and animals.

A continued human presence in the core zone would provide an ongoing, active institutional interest vested in future management of the risks posed by Hanford waste. One way to ensure this continuous human presence is to maximize the potential for any beneficial use of the accessible areas of the core zone, rather than rely only on long-term government control of these areas.

Groundwater remediation must be an integral part of source term remediation. This effort should include aggressive technology development and implementation. Risk assessments must include all aspects of groundwater and vadose zone. Groundwater is a valuable resource with beneficial future uses that must not be restricted outside of the individual waste management unit points of compliance within the core zone.

The Board believes that sound management, stewardship, and cleanup decisions must begin now to build equity over generations. The Tri-Parties need to engage immediately in developing robust, flexible, and creative management systems to address long-term stewardship. The Board recommends that a coalition of groups, to include the Tribes, local government, and other affected entities as appropriate be created to administer the long-term stewardship responsibilities for this site. Stewardship should be an active process involving the entire spectrum of management, education, and protection activities.

For the Central Plateau, the Board advises the agencies to analyze a range of potential human health and ecological risks, including the reasonable maximum risk expected over time. The stakeholder community will use this analysis to advise the agencies on appropriate cleanup decisions. The risk analysis should include: a reasonable maximum exposure to a resident and/or Native American, including groundwater use, in what is currently labeled the buffer zone and in areas freed up for use as the core zone shrinks. For the waste management areas within the core zone, exposure scenarios should include a reasonable maximum exposure to a worker/day user, to possible Native American users, and to intruders.

The Board also recommends that DOE continue to refine its ability to make accurate risk projections by continuing efforts to gather the data necessary to accurately characterize waste inventories and locations. The results of these analyses should be provided as soon as possible and in a publicly useful format that depicts geographic variations of risks over time.

Finally, the Board believes the values expressed by the Future Site Uses Working Group are still applicable. These values should continue to be used as a guide for making cleanup decisions.

Sincerely,

Todd Martin, Chair
Hanford Advisory Board

This advice represents HAB consensus for this specific topic. It should not be taken out of context to extrapolate Board agreement on other subject matters.

cc: Wade Ballard, Deputy Designated Federal Official, U.S. Department of Energy
Michael Gearheard, Environmental Protection Agency
Michael Wilson, Washington State Department of Ecology
Martha Crosland, U.S. Department of Energy Headquarters
The Oregon and Washington Congressional Delegations

U.S. Senators (OR)
Gordon H Smith
Ron Wyden

U.S. Senators (WA)
Maria Cantwell
Patty Murray

U.S. Representatives (OR)
Earl Blumenauer
Peter DeFazio
Darlene Hooley
Greg Walden

U.S. Representatives (WA)
Norm Dicks
Jennifer Dunn
Richard Hastings
George Nethercutt

State Senators (WA)
Pat Hale
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